

CLAIMS

We claim:

1. A method for making an infrared-reflective roofing product, the method comprising:
 - (a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,
 - (b) applying at least one powder of an infrared-reflective material to the bitumen-coated web, and
 - (c) applying roofing granules to the bitumen-coated web.
2. A method according to claim 1 wherein the roofing granules comprise infrared-reflective roofing granules.
3. A method according to claim 1 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.
4. A method according to claim 1 wherein the infrared-reflective roofing product is colored and has an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.
5. An infrared-reflective roofing product comprising:
 - (a) a fibrous web coated with a bituminous coating forming a bitumen-coated web,
 - (b) a coating of at least one powder of an infrared-reflective material applied to the bitumen-coated web, and
 - (c) roofing granules applied to the bitumen-coated web.
6. An infrared-reflective roofing product according to claim 5 wherein the roofing granules comprise infrared-reflective roofing granules.
7. An infrared-reflective roofing product according to claim 5 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron

oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.

8. An infrared-reflective roofing product according to claim 5 having an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

9. A method for making an infrared-reflective roofing product, the method comprising:

(a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,

(b) applying a coating material to the bitumen-coated web, the bitumen-coated web having a surface temperature, the coating material comprising:

(i) a carrier, and

(ii) at least one powder of an infrared-reflective material, and

(c) applying roofing granules to the bitumen-coated web.

10. A method according to claim 9 wherein the coating material has a melting temperature less than the surface temperature of the bitumen-coated web, the coating material melting upon application to the bitumen-coated web.

11. A method according to claim 9 wherein the roofing granules comprise infrared-reflective roofing granules.

12. A method according to claim 9 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.

13. A method according to claim 9 wherein the infrared-reflective roofing product is colored and has an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

14. An infrared-reflective product comprising:

(a) a fibrous web coated with a bituminous coating forming a bitumen-coated web,

(b) a coating material including a carrier and at least one powder of an infrared-reflective material applied to the bitumen-coated web, and

(c) roofing granules applied to the bitumen-coated web.

15. An infrared-reflective roofing product according to claim 14 wherein the roofing granules comprise infrared-reflective roofing granules.

16. An infrared-reflective roofing product according to claim 14 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.

17. An infrared-reflective roofing product according to claim 14 having an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

18. A method for making an infrared-reflective roofing product, the method comprising:

- (a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,
- (b) applying a coating film to the bitumen-coated web, the bitumen-coated web having a surface temperature, the coating film comprising:
 - (i) a film carrier, and
 - (ii) at least one powder of an infrared-reflective material, and
- (c) then applying roofing granules to the bitumen-coated web.

19. A method according to claim 18 wherein the coating film has a melting temperature less than the surface temperature of the bitumen-coated web, the coating film melting upon application to the bitumen-coated web to adhere the coating film to the bitumen-coated web.

20. A method according to claim 18 wherein the roofing granules comprise infrared-reflective roofing granules.

21. A method according to claim 18 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.

22. A method according to claim 18 wherein the infrared-reflective roofing product is colored and has an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

23. An infrared-reflective roofing product comprising:

(a) a fibrous web coated with a bituminous coating forming a bitumen-coated web,

(b) a coating film including a film carrier and at least one powder of an infrared-reflective material applied to the bitumen-coated web, and

(c) roofing granules applied to the bitumen-coated web.

24. An infrared-reflective roofing product according to claim 23 wherein the roofing granules comprise infrared-reflective roofing granules.

25. An infrared-reflective roofing product according to claim 23 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.

26. An infrared-reflective roofing product according to claim 23 having an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

27. A method for making an infrared-reflective roofing product, the method comprising:

(a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,

(b) applying a coating web to the bitumen-coated web, the bitumen-coated web having a surface temperature, the coating web comprising:

(i) a web carrier,

(ii) at least one powder of an infrared-reflective material, and

(iii) roofing granules.

28. A method according to claim 27 wherein the web carrier has a melting temperature less than the surface temperature of the bitumen-coated web, the web carrier melting upon application to the bitumen-coated web.

29. A method according to claim 27 wherein the roofing granules comprise infrared-reflective roofing granules.

30. A method according to claim 27 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.
31. A method according to claim 27 wherein the infrared-reflective roofing product is colored and has an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.
32. An infrared-reflective product comprising:
- (a) a fibrous web coated with a bituminous coating forming a bitumen-coated web,
 - (b) a coating web including a web carrier, at least one powder of an infrared-reflective material and roofing granules, the coating web being applied to the bitumen-coated web.
33. An infrared-reflective roofing product according to claim 32 wherein the roofing granules comprise infrared-reflective roofing granules.
34. An infrared-reflective roofing product according to claim 32 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.
35. An infrared-reflective roofing product according to claim 32 having an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.
36. A method for making an infrared-reflective roofing product, the method comprising:
- (a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,
 - (b) applying roofing granules to the bitumen-coated web to form an intermediate product; and
 - (c) applying a coating film to the intermediate product, the intermediate product having a surface temperature, the coating film comprising:

- (i) a film carrier, and
- (ii) at least one powder of an infrared-reflective material.

37. A method according to claim 36 wherein the coating film has a melting temperature less than the surface temperature of the intermediate product, the coating film melting upon application to the intermediate product to adhere the coating film to the intermediate product.

38. A method according to claim 36 wherein the roofing granules comprise infrared-reflective roofing granules.

39. A method according to claim 36 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.

40. A method according to claim 36 wherein the infrared-reflective roofing product is colored and has an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

41. An infrared-reflective roofing product comprising:

- (a) a fibrous web coated with a bituminous coating forming a bitumen-coated web,
- (b) roofing granules applied to the bitumen-coated web to form an intermediate product, and
- (c) a coating film including a film carrier and at least one powder of an infrared-reflective material applied to the intermediate product.

42. An infrared-reflective roofing product according to claim 41 wherein the roofing granules comprise infrared-reflective roofing granules.

43. An infrared-reflective roofing product according to claim 41 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers; and, wherein the infrared-reflective roofing product has a deep-tone color.

44. An infrared-reflective roofing product according to claim 41 having an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

45. A method for making an infrared-reflective roofing product, the method comprising:

- (a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,
- (b) applying roofing granules to the bitumen-coated web to form an intermediate product; and
- (c) applying a coating fluid to the intermediate product, the coating material comprising:
 - (i) a fluid carrier, and
 - (ii) at least one powder of an infrared-reflective material.

46. A method according to claim 45 wherein the roofing granules comprise infrared-reflective roofing granules.

47. A method according to claim 45 wherein the at least one powder is selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.

48. A method according to claim 45 wherein the infrared-reflective roofing product is colored and has an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.

49. A method for making an infrared-reflective roofing product, the method comprising:

- (a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,
- (b) applying at least one dispersed infrared-reflective material to the bitumen-coated web, and
- (c) applying roofing granules to the bitumen-coated web.

50. A method according to claim 49 wherein the roofing granules comprise infrared-reflective roofing granules.

51. A method according to claim 49 wherein the at least one dispersed infrared-reflective material includes an infrared material selected from the group consisting of titanium dioxide pigments, nickel titanate pigments, chrome titanate pigments, nano-TiO₂ particles, light-interference platelet pigments, pearlescent pigments, metal-oxide coated substrate pigments, iron oxide yellow pigments, iron titanium oxides, metal flakes, silica encapsulated metal flakes, light-scattering pigments, and mirrorized fillers.
52. A method according to claim 49 wherein the infrared-reflective roofing product is colored and has an L* value of less than 60 and a solar heat reflectance of greater than 25 percent.
53. A method according to claim 49 further including dispersing an infrared-reflective material in a carrier to provide the dispersed infrared-reflective material.
54. A method according to claim 53 wherein the infrared-reflective material is dispersed in a fluid carrier.
55. A method according to claim 54 wherein the fluid carrier including the dispersed infrared-reflective material is applied as a fluid coating to the bitumen-coated web.
56. A method according to claim 55 wherein the fluid carrier is selected from the group consisting of water-borne coatings, solvent-based coatings, two-part reactive liquid coating, and hot melt coatings.
57. A method according to claim 53 wherein the infrared-reflective material is dispersed in a powder coating.
58. A method according to claim 54 wherein the fluid carrier including the dispersed infrared-reflective material is formed into a film, and the film is subsequently applied to the bitumen-coated web.
59. A method according to claim 58 wherein the film is selected from the group consisting of thermoplastic films and thermosetting films.
60. A method according to claim 58 wherein the film is applied using a method selected from the group consisting of lamination, extrusion, and coating.
61. A method according to claim 49 wherein the at least one dispersed infrared-reflective material is applied to the bitumen-coated web before applying roofing granules to the bitumen-coated web.

62. A method according to claim 49 wherein the roofing granules are applied to the bitumen-coated web before applying the at least one dispersed infrared-reflective material to the bitumen-coated web.

63. A method for making an infrared-reflective roofing product, the method comprising:

(a) coating a fibrous web with a bituminous coating at an elevated temperature to form a bitumen-coated web,

(b) applying roofing granules to the bitumen-coated web, the roofing granules comprising a blend of:

(1) off-white roofing granules comprising Al_2O_3 and SiO_2 , and

(2) roofing granules selected from the group consisting of conventional colored roofing granules and infrared-reflective roofing granules, the blend being selected to provide an infrared-reflective roofing product having an L^* < 60 and a solar reflectance greater than 25%.

64. A method according to claim 63 wherein the roofing granules include at least 50 percent by weight off-white mineral granules.

65. A method according to claim 63 wherein the off-white mineral granules comprising Al_2O_3 and SiO_2 have a weight ratio of Al_2O_3 to SiO_2 from about 0.2:1 to about 1:1.

66. A method according to claim 65 wherein the off-white mineral granules comprising Al_2O_3 and SiO_2 have a weight ratio of Al_2O_3 to SiO_2 from about 0.7:1 to about 0.9:1.